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FLOOD INSURANCE STUDY

CITY OF STERLING, COLORADO
LOGAN COUNTY

SEPTEMBER 29, 1989

Federal Emergency Management Agency

COMMUNITY NUMBER - 080294

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

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FLOOD INSURANCE STUDY
CITY OF STERLING, LOGAN COUNTY, COLORADO

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City of Sterling, Logan County, Colorado, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

This Flood Insurance Study was prepared by compiling pertinent information for the flood hazard areas in the City of Sterling, Colorado, from existing technical and/or scientific data originally prepared by others.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these federally supported studies are based. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses used to prepare this study were performed by the U.S. Army Corps of Engineers (COE), Omaha District and Charles F. Leaf, P.E. These analyses were completed in September 1978, and January 1987, respectively.

1.3 Coordination

On August 7, 1987, the Federal Emergency Management Agency (FEMA) notified the City of Sterling that a Flood Insurance Study was being prepared for the community.

On April 27, 1988, the results of this study were reviewed and accepted at a final coordination meeting attended by representatives of the community and FEMA.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of Sterling, Logan County, Colorado. The areas of study are shown on the Vicinity Map (Figure 1).

The South Platte River was studied by detailed methods throughout Logan County, however only that portion of the reach affecting the City of Sterling is shown. Pawnee Creek Overflow was studied by detailed methods within the City of Sterling from the mouth to its confluence with Sterling No. 1 Ditch, a reach of approximately 2.3 miles. Sand Creek was studied by detailed methods from a point approximately 90 feet downstream of State Highway 138 to a point approximately 110 feet upstream of Hall Road, a reach of approximately 3.4 miles.

The areas studied by detailed methods were selected based upon the extent and validity of available existing hydrologic and hydraulic data.

2.2 Community Description

The City of Sterling, the county seat of Logan County, is located approximately 125 miles northeast of Denver, 132 miles east of Boulder, and 126 miles southeast of Cheyenne, Wyoming. According to 1980 census data, Sterling had a population of 11,385, an increase of approximately 7 percent over the 1970 population of 10,636 (Reference 1). The climate of Sterling is primarily affected by northwestern winds. The average annual precipitation is 19 inches and the average annual snowfall is 39.4 inches. The mean annual temperature is 48.6°F and the average annual number of clear days is 299. The coldest month is January with a mean temperature of 38.8°F and the warmest month is July with an average temperature of 89.0°F. The topography of the City of Sterling consists of high rolling plains. The total land area within the City of Sterling is 5.33 square miles.

2.3 Principal Flood Problems

Flooding along the South Platte River, Pawnee Creek Overflow, and Sand Creek in the Sterling area normally occurs from March through September with the most frequent flooding occurring during June. Annual peak discharges, however, have been recorded throughout the year. Floods in the Sterling area normally occur under conditions not affected by ice. Ice jams, however, are possible on the South Platte River although their historical frequency of occurrence is rare. Irrigation works also influence flooding in the Sterling area by the diversion of floodwaters.

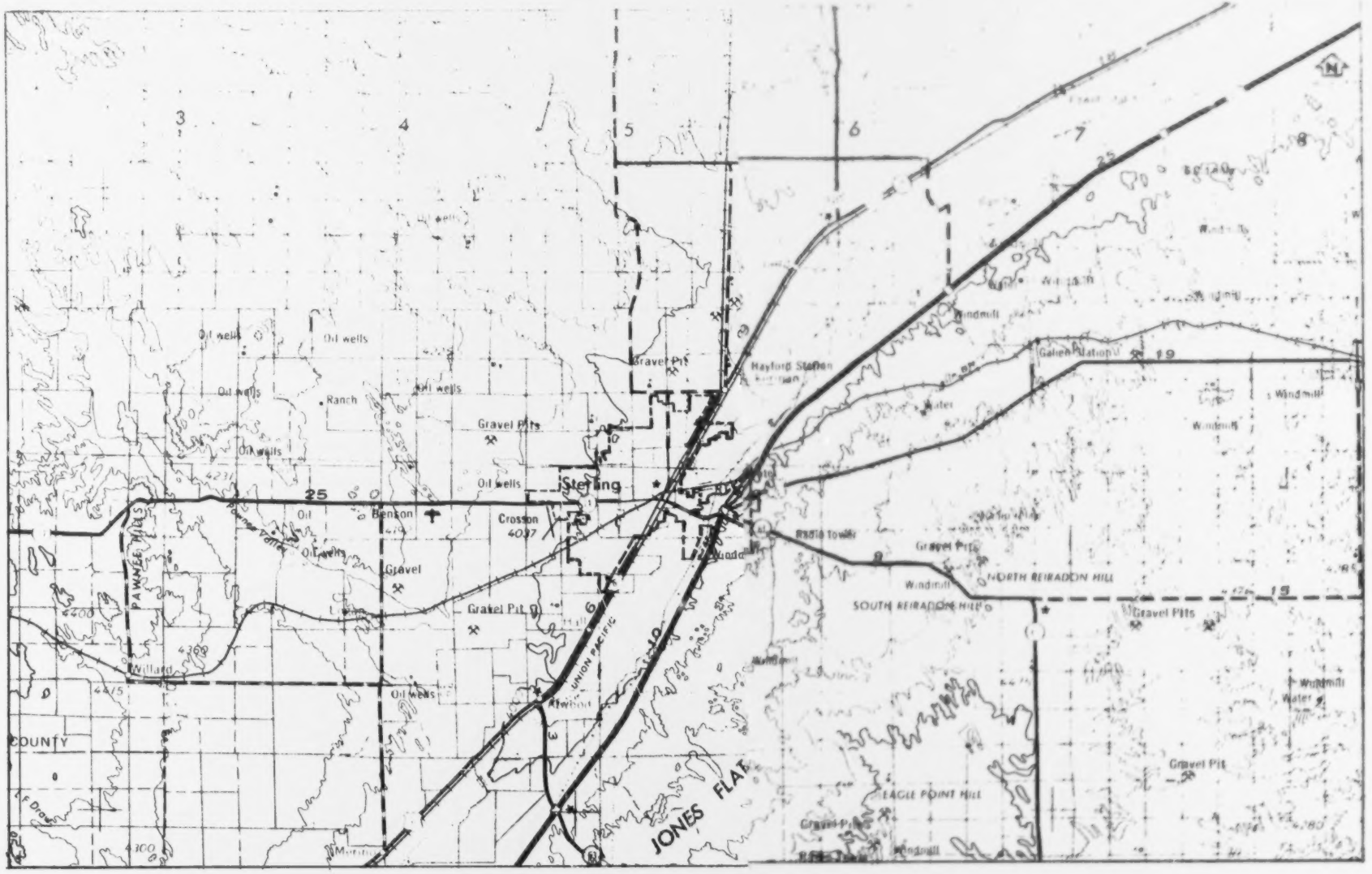


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF STERLING, CO
(LOGAN COUNTY)

APPROXIMATE SCALE

4 0 4 8 16 MILES

VICINITY MAP

Floodwaters on the South Platte River, Pawnee Creek Overflow, and Sand Creek in the vicinity of Sterling can result from intense localized rainfall or general rains, either of which may be augmented by snowmelt. The intense rainstorm floods result from intense rainfall over areas of relatively small area extent. These storms can produce extremely rapid concentrations of floodwaters and resultant rapid rises in stream levels. Because of little warning time prior to streams attaining flood stages, this type of storm can produce floods which are extremely hazardous. This type of flood produces high peak discharges on tributaries in the general vicinity of the rainstorm. The discharge, however, attenuates rapidly on the South Platte River downstream from the contributing tributaries due to valley storage of the floodwater.

Erosive effects can be considerable in the event of any flood regardless of its origin. Floods resulting from intense rainstorms typically create severe erosion damages in a short period of time due to the relatively large peak discharge and high velocity of the floodwater. Erosion damages from snowmelt or general rainstorm floods usually result from prolonged exposure to the floodwater because of the long duration typical of these floods.

The Pawnee Creek Overflow floodplain in the Sterling area is traversed by U.S. Highway 6, State Highways 14 and 138, and the combined Union Pacific and Burlington Northern Railroads. Their embankments divert runoff out of natural channels, while undersized bridges and culverts severely restrict floodflows. Hence, much of the existing flood hazard in Sterling would be reduced simply by replacing inadequate crossings with larger hydraulic structures. The most severe constrictions are the U.S. Highway 6 and Union Pacific Railroad bridge at Pawnee Creek south of Sterling, the Burlington Northern Railroad bridge at Pioneer Ditch, the State Highway 14 bridge at Pioneer Ditch, and the State Highway 138/Burlington Northern/Union Pacific Railroad bridge at Pioneer Ditch.

During periods of high flood stages on Pawnee Creek, floodwater can escape the Pawnee Creek channel to flow overland toward the South Platte River. However, these floodwaters are intercepted by highway and railroad embankments, which redirect the floodwater toward Sterling. This overflow is referred to as the "Pawnee Creek Overflow" in this report. This redirected floodwater flows northerly along the west side of State Highway 138 and the Union Pacific Railroad, past the Riverside Cemetery, and then through the City of Sterling.

Ice effects have, historically, not been a problem on the South Platte River or Pawnee Creek Overflow in the Sterling area. A remote chance of ice jams exists on the South Platte River.

2.4 Flood Protection Measures

The City of Sterling presently has no flood protection measures within the corporate limits.

3.0 ENGINEERING METHODS

For the flooding sources studied by detailed methods in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, and 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1-percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). the analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied by detailed methods affecting the community.

The general rainstorm floods result from rainfall over areas of large areal extent. Rainfall from this type of storm may occur over several days. Because of this time duration, the affected streams rise relatively slowly. The duration of the flood period also is sometimes of considerable length. Because of the large areal extent of rainfall, many tributaries contribute to the peak discharge. This results in progressively increasing discharges downstream. However, downstream from the contributing tributaries, the effects of valley storage cause flood discharge attenuation.

Discharge magnitudes for floods on the South Platte River were based upon data collected at U.S. Geological Survey stream gaging stations located at Denver, Henderson, Kersey, Weldona, Balzac, and Julesburg, all located in Colorado. Discharge values developed at Sterling were part of an overall South Platte River study. Peak discharge probability relationships were developed from these records. A basin model was developed to determine discharge probability relationships for locations other than at the stream locations.

Peak flows from the hydrologic analysis were used as inputs to the COE HEC-2 water-surface profile computer model (Reference 2). This model provided estimates of the water-surface elevations for each

of the 10- through 500-year flood events. The water-surface profiles were transferred to topographic maps to establish the 100-year floodplain boundaries.

A hydrologic analysis was made to determine peak flow rates for various storm frequencies at several locations in the City of Sterling for both Sand Creek floods and Pawnee Creek overflows. Synthetic hydrographs were computed for 10-, 50-, 100-, and 500-year frequency storms. Flood peaks were determined assuming the simultaneous occurrence of a 10-year flood on the South Platte River.

Peak discharge-drainage area relationships for South Platte River, Pawnee Creek Overflow, and Sand Creek are shown in Table 1.

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA Sq. Miles	PEAK DISCHARGE (cfs) 10-year	50-year	100-year	500-year
South Platte River Just upstream of Sterling	18,000	18,000	55,000	84,000	207,000
Pawnee Creek Overflow At State Highway 138	38.7	1,250	2,400	5,000	11,000
Sand Creek At Mouth	31.6	250	3,700	4,400	12,000

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the riverine sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross sectional data along the South Platte River were obtained from aerial photographs taken on December 19, 1976, by Blevins Mapping Company of Denver, Colorado. These maps had a scale of 1 inch equal to 200 feet and a contour interval of 2 feet.

Cross sectional data along Sand Creek and Pawnee Creek Overflow were provided in HEC-2 format by the City of Sterling.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1), and are also shown on the Flood Insurance Rate Map (Exhibit 2).

Channel roughness factors for all streams studied by detailed methods ranged from 0.06 to 0.07 in the overbank areas and from 0.04 to 0.05 in the channel.

The starting water-surface elevations for the South Platte River, Pawnee Creek Overflow, and Sand Creek were determined by the slope area method, 10-year coincident peak, and 10-year coincident peak, respectively.

Flood profiles were drawn showing the computed water-surface elevations for floods of the selected recurrence intervals.

The hydraulic analyses for this study are based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps; the descriptions of the marks are presented in Elevation Reference Marks (Exhibit 3).

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study includes a floodplain boundary map designed to assist communities in developing sound floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied by detailed methods, the boundaries of the 100- and 500-year floodplain boundaries have been delineated using the flood elevations determined at each cross section.

Between cross sections, the boundaries along the South Platte River were interpolated using detailed topographic maps prepared by Blevins Mapping Company of Denver, Colorado in 1977. The maps were at a scale of 1 inch equal to 200 feet with a 2-foot contour interval.

For Sand Creek and Pawnee Creek Overflow, Blevins Mapping Company and Landmark Mapping, Lakewood, Colorado, produced maps in 1976 and 1981, respectively. These maps were at a scale of 1 inch equal to 200 feet with a 2-foot contour interval.

The 100- and 500-year floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zone AE and AO), and the 500-year floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 100- and 500-year floodplain boundaries are close together, only the 100-year floodplain

boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management development against the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. Floodways were not computed for this study.

5.0 INSURANCE APPLICATION

For flood insurance rating purposes flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually sheetflow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain, areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 100- and 500-year floodplains, and the locations of selected cross sections used in the hydraulic analyses.

7.0 OTHER STUDIES

This Flood Insurance Study was prepared by compiling existing hydrologic and hydraulic data, and utilizing technical and scientific data prepared by other organizations originally for purposes other than the NFIP. The data were identified as the best available at the time of compilation of this FIS and should depict the general conditions of the flooding sources with relative accuracy. FEMA performed a cursory review and accepted the data as valid for purposes of this FIS and the NFIP. However, if better information is known to exist or has been developed since the date of this report, the information should be immediately forwarded to the Natural and Technological Hazards Division, Federal Emergency Management Agency, Denver Federal Center, Building 710, Box 25267, Denver, Colorado 80225-0267 for consideration for revision of this study.

This Flood Insurance study was prepared using technical data contained in two Flood Plain Information Reports, one prepared by the COE, Omaha District, and another prepared by Charles F. Leaf, P.E. (References 3 and 4).

A Flood Hazard Boundary Map has been published for the community (Reference 5). The differences between the Flood Hazard Boundary Map and this study are justified due to the more detailed nature of this Flood Insurance Study.

This report either supersedes or is compatible with all previous studies published on streams studied in this report and should be considered authoritative for the purposes of the NFIP.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, Federal Emergency Management Agency, Denver Federal Center, Building 710, Box 25267, Denver, Colorado 80225-0267.

9.0 BIBLIOGRAPHY AND REFERENCES

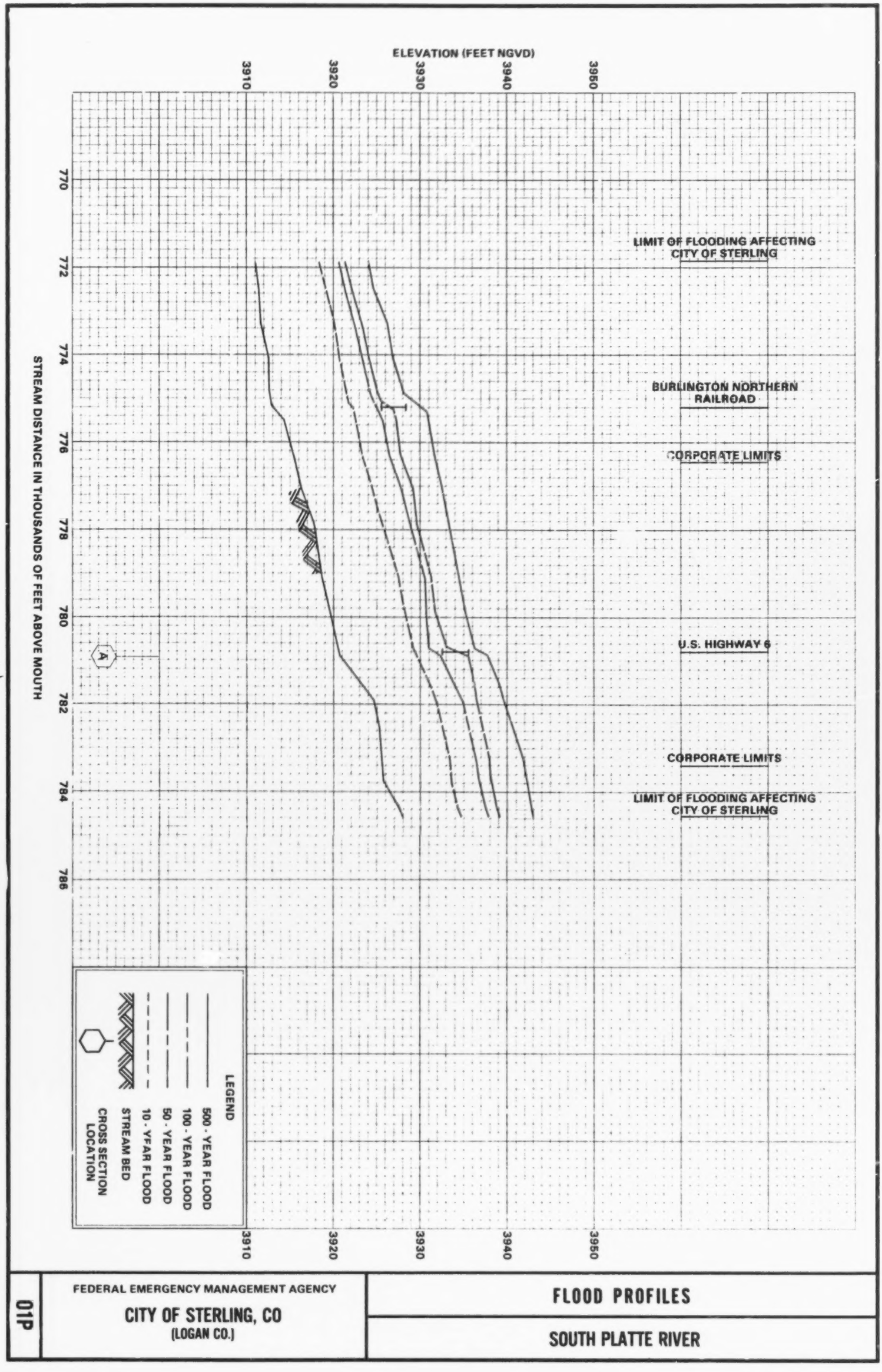
1. U.S. Department of Commerce, Bureau of the Census, 1980 Census of Population, Number of Inhabitants, Colorado.

2. U.S. Army Corps of Engineers, HEC-2 Water Surface Profiles Hydrologic Engineering Center, Davis, California, 1981.

3. U.S. Army, Corps of Engineers. Floodplain Information: South Platte River and Pawnee Creek, Sterling, Colorado. Omaha District, Omaha, Nebraska, 1978.

4. Leaf, Charles F., and Resource Consultants, Inc. Floodplain Information and Drainage Plan: Sand Creek and the Pawnee Creek Overflow at Sterling Colorado, Submitted to the City of Sterling and the Colorado Water Conservation Board, Sterling, Colorado, 1983.

5. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, City of Sterling, Logan County, Colorado, July 3, 1979.



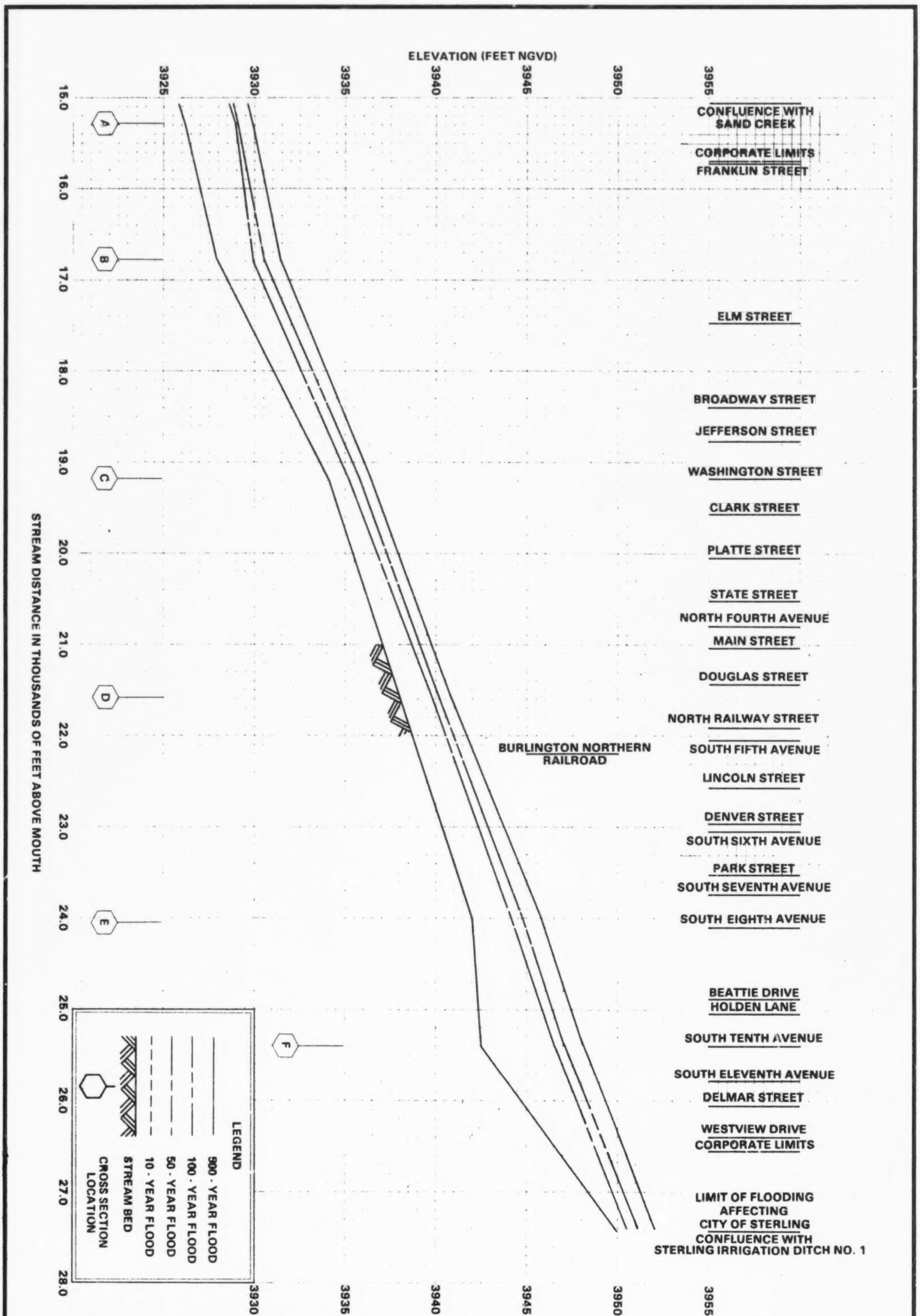
01P

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF STERLING, CO
(LOGAN CO.)

FLOOD PROFILES

SOUTH PLATTE RIVER



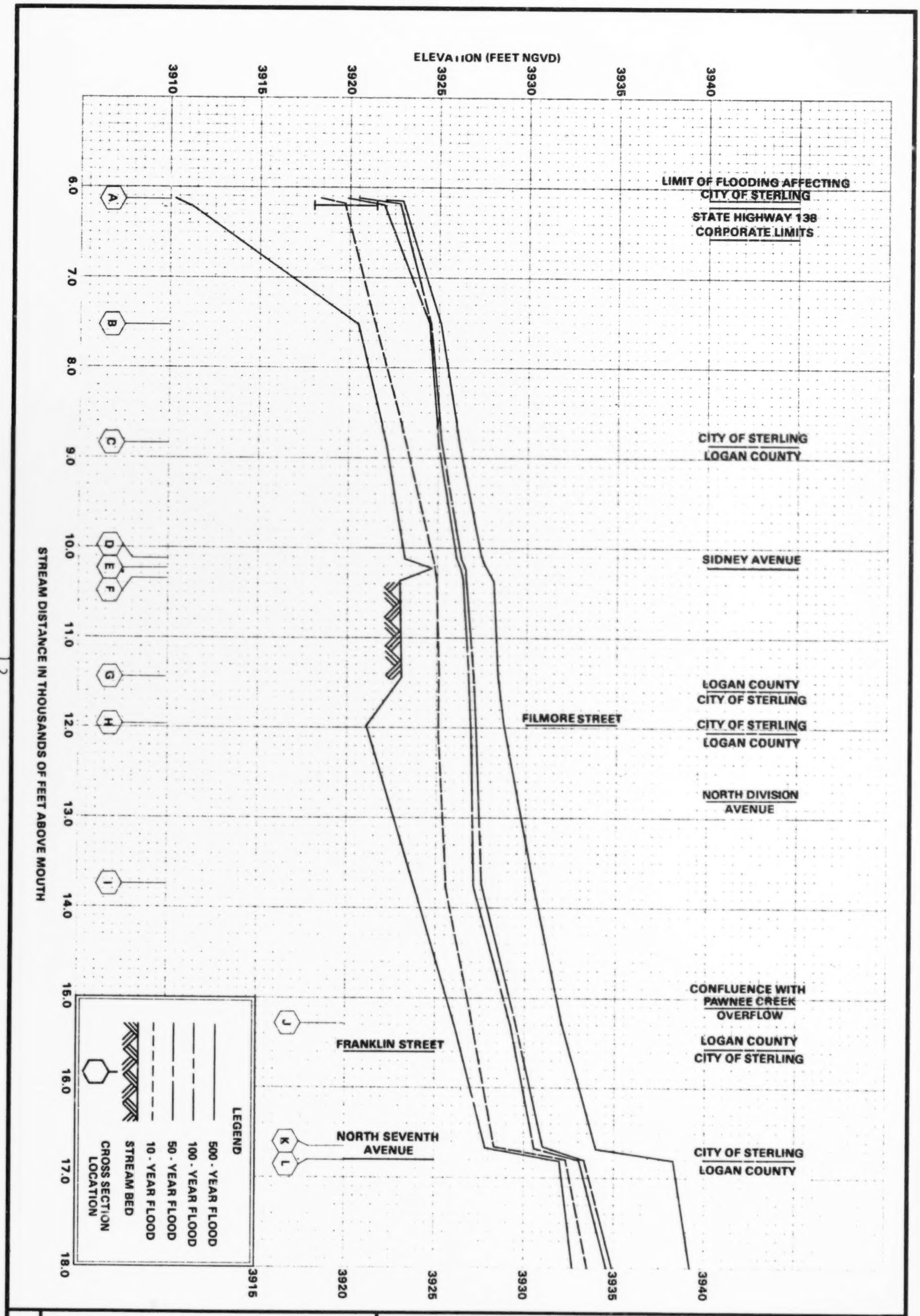
02P

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF STERLING, CO
(LOGAN CO.)

FLOOD PROFILES

PAWNEE CREEK OVERFLOW



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FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF STERLING, CO
(LOGAN CO.)

FLOOD PROFILES

SAND CREEK

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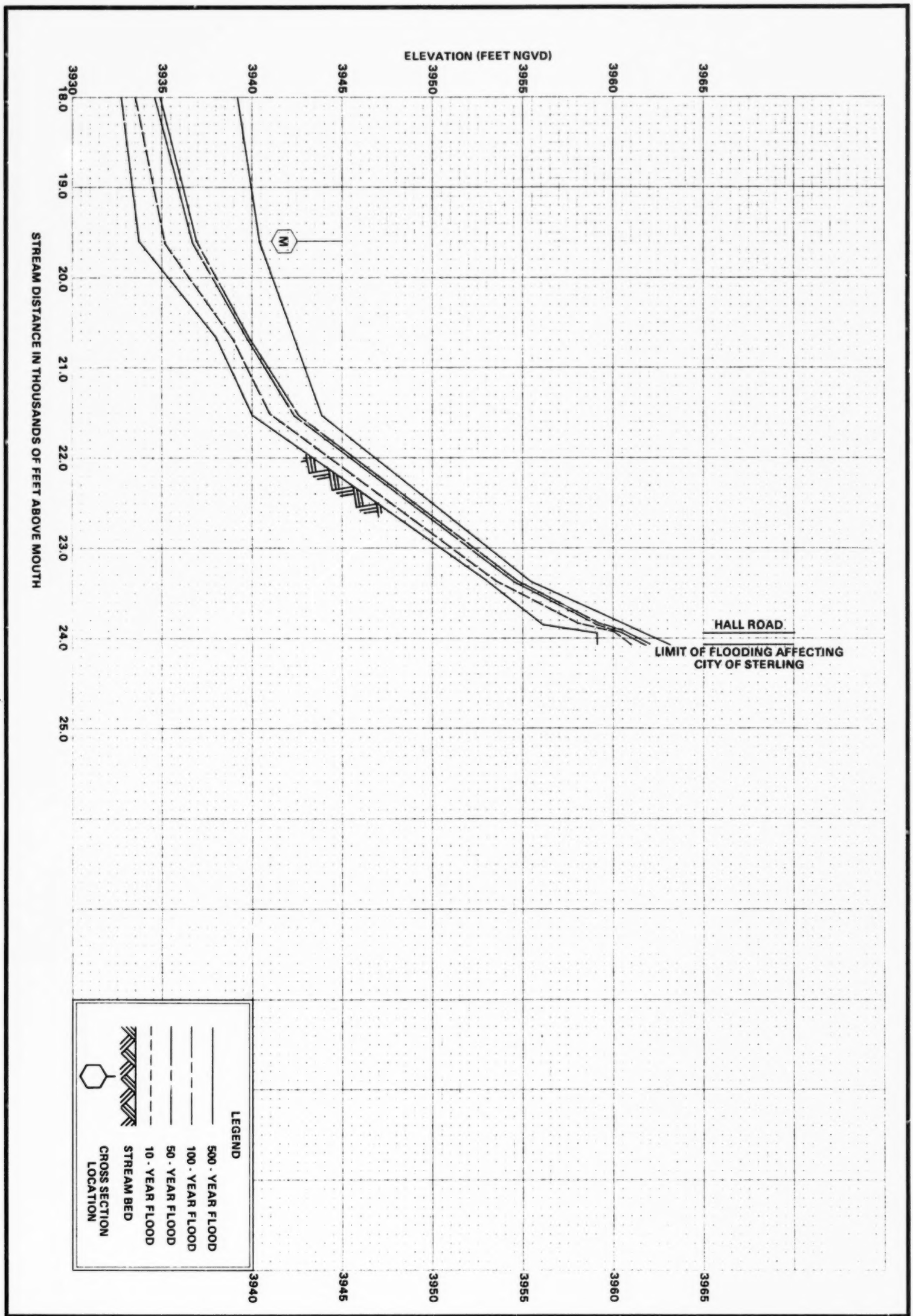

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FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF STERLING, CO
(LOGAN CO.)

FLOOD PROFILES

SAND CREEK

EXHIBIT 3 - ELEVATION REFERENCE MARKS
CITY OF STERLING, LOGAN COUNTY, COLORADO

Reference Mark	Elevation feet (NGVD)	Description of Location
RM1	3924.61	North Division Avenue and drainage ditch road. (No.46). Brass cap set in 6 inch concrete post on north side of drainage ditch road, 7.0 feet north of asphalt at west end of barricade.
RM2	3931.55	North Seventh Avenue and Franklin Street (No.43). Brass cap set in 6-inch concrete post in southwest quadrant of intersection. 35.0 feet south of centerline of Franklin Street and 40.0 feet west of centerline of North Seventh Avenue.
RM3	3926.74	North Sidney Avenue and Logan Street (No. 21-A). Brass cap set in 6 inch concrete post in southeast quadrant of intersection, 0.3 feet back of sidewalk and 6.3 feet from powerpole.
RM4	3931.95	At Heritage Center at North Division Avenue and Broadway Street (No.23). Brass cap set in southwest corner of flagpole base.
RM5	3964.14	Highway No.14 and Iris Drive (No.55). Highway right-of-way marker in southeast quadrant of Highway 14 and Iris Drive.
RM6	3937.81	West Main and North Seventh Avenue (No.27). Brass cap set in sidewalk on south side of west main near lamppole. 5.5 feet south of curb and 15 feet east of centerline of North Seventh Avenue.
RM7	3945.90	South Sixth Avenue and Iris Drive (No.63). Brass cap set in top of curb in northwest quadrant of intersection.